

SOME NOTES ON NITROUS OXID AND OXYGEN FOR PROLONGED ANESTHESIA AND A REPORT OF A FEW CRITICAL CASES.

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Nitrous oxid has seldom been used on this Coast as an anesthetic in major surgery, although extensively used by some surgeons in the East.* The addition of oxygen to nitrous oxid places it foremost among the anesthetics, because, following it the patient is strikingly better off than after ether narcosis.¹

The following cases are of interest because they represent its most extensive use for major surgery in San Francisco as yet. I have successfully used nitrous oxid and oxygen for prolonged anesthesia in abdominal hysterectomies, appendectomies, oophorectomies, salpingectomies, exploratory laparotomies, for gastro enterostomy, cholecystotomy, ventral herniotomy, sigmoidexy, pneumotomy exophthalmic and simple goitre, mastoid, epithelioma of the face, epididymectomy, curetments, repair of the cervix and perineus, injections of the trifacial and supra orbital nerves, iridectomy, tonsillectomy, dental surgery, numerous cases of tonsillotomy, and many other minor operations, also experimentally to obtain positive pressure in chest surgery on a dog, proving the success of Dr. Bunnell's invention.²

Method Used. The anesthetic was begun with nitrous oxid alone, then about 2 per cent oxygen was added, which was gradually increased to 6, 8 or 12 per cent or higher when any cyanosis was present. From 100 to 250 gallons nitrous oxid was used an hour. A few of the cases had nitrous oxid ether, nitrous oxid and oxygen sequence³ where the surgeons wished to be assured of relaxation. When ether was used the amount was very small and given for a few minutes only. In all long operations the gases were heated before inhalation.**⁴ The apparatus used was the Teter, whose transparent face mask leaves the patient's features visible, by which the ether can be added without removing the mask; a definite percentage of oxygen added, and with which the vapors can be warmed and given under slight pressure.

The adults received a hypodermic of morphin gr. $\frac{1}{4}$ and atropin gr. $\frac{1}{150}$, half an hour before operation.***

Report of a Few Critical Cases. Although it is a temptation to give a detailed account of many of the cases in my enthusiasm over the good results obtained, the only cases of real value are the operative risks where any other general anesthetic might have proved dangerous.

Case I. Thyroidectomy for Exophthalmic Goitre. After removal the gland weighed thirteen ounces. Nitrous oxid and oxygen anesthesia lasting one hour and nineteen minutes. The woman was very emaciated and extremely nervous and only after long persuasion entered the operating room. Before operation her pulse rate was 160 and weak, but during anesthesia it became stronger and went down to 120 a minute. The patient talked and laughed for the first minute, but after that the anesthesia was perfect. The patient was awake three minutes after the gas was discontinued and was not in the least nauseated.

Case II. Abdominal Herniotomy. Patient was suffering from shock and sepsis. Temperature 101.4°, pulse 140 and thready; white blood count 22,000 and hemoglobin 50. Pan-hysterectomy had been performed five days before. Sutures had ruptured and eight inches of bowel had protruded from wound for ten hours previous to second operation. Patient was constantly vomiting fecal matter. Patient had nitrous oxid and oxygen anesthesia for one hour and five minutes. Patient recovered, which would not have been likely after the decreased immunity to infection following ether or chloroform.

Case III. Mastoid. Patient a child of eight with an acute bronchitis and a dilated heart. White blood count 12,000, pulse rate 120. Nitrous oxid ether, nitrous oxid and oxygen sequence, lasting about 55 minutes. Pulse became very rapid and feeble toward end of operation, but color remained good. The patient was stimulated with caffeine. On account of the weakened heart muscle, nitrous oxid would not have been safe if any cyanosis existed, but by using a high percentage of oxygen it was probably the best anesthetic for this case where any anesthetic, was counterindicated. The child kept cracked ice down immediately after put to bed, and in about an hour had ice cream, suffering from no nausea whatever, and in two hours the pulse had lowered to 100 and was much stronger. In another case with a much more serious heart condition I gave N₂O and oxygen for 25 minutes (following a spinal anesthesia), in a prostatectomy for a malignant growth, without any harmful result, but did not consider it the anesthetic of choice here.

Case IV. Exploratory Laparotomy. Anesthetic nitrous oxid, ether, nitrous oxid and oxygen sequence lasting 25 minutes. Patient's condition very grave. One week before had a laparotomy to perform gastroenterostomy, as no food had passed through pylorus for a long time, but after breaking up numerous adhesions all over the intestines, patient's condition so poor that gastroenterostomy postponed. Present operation, abdomen tense with fluid, two large masses in liver and after abdomen reopened surgeons decided to drain for temporary relief. Patient not relaxed from ether when nitrous oxid and oxygen begun, but relaxation perfect under nitrous oxid oxygen; in this case anesthesia under gas more satisfactory than the ether narcosis. Patient was awake two minutes after gas discontinued and vomited a couple of drams of mucus on recovery.

Case V. Diabetic Case. Opening, curetting, draining indurated area in abdominal wall. Nitrous oxid and oxygen anesthesia lasting 16 minutes. Patient 60 years of age, weighing over 200 pounds. Had acetone, diacetic acid and casts in urine beside the sugar. Patient vomited once on awakening from gas, but otherwise made good recovery.

Case VI. Supra-vaginal Hysterectomy. Nitrous oxid and oxygen anesthesia lasting 2 hours and 5 minutes. Nitrous oxid indicated because of infected genito-urinary tract and because of excessive vomiting following ether after previous laparotomy for removal of tubes and ovaries performed in the country. Patient had large quantity of pus in urine due to a very severe cystitis. As catheterization was very painful, bladder was washed out under nitrous

oxid and oxygen anesthesia and patient put in Trendelenberg position before incision was made. At end of 45 minutes surgeon complained of rigidity and patient was given 2 ounces ether along with the gas and oxygen during the next five minutes, which gave the desired relaxation until the end of the operation. Patient was talking to us three minutes after last stitch was taken and had no post-operative nausea, or other ill effects.

Length of Anesthesia. The period of anesthesia in the above list of operations lasted from five minutes to over two hours. Two hours and five minutes is the longest nitrous oxid and oxygen anesthetic given in San Francisco as yet. It has been used for over three hours by anesthetists in the Eastern States. There is no limit to the length of time it can be used. Claude Lyons and Martin both have given a dog nitrous oxid and 15 per cent oxygen for three continuous days without any harmful results.

Nitrous Oxid and Oxygen versus Nitrous Oxid and Air Anesthesia. Nitrous oxid and oxygen anesthesia means that the patient breathes nothing but gas and oxygen throughout the operation, the mask being adjusted so that no air is admitted during the whole period. Those who have only seen nitrous oxid used without oxygen for momentary operations or to begin ether narcosis usually have witnessed some unpleasant experiences. Occasionally when an overdose is given those present may be frightened by asphyxial symptoms such as cyanosis, jactitations, clonic convulsions and even cessation of respiration,**** but the danger of these alarming symptoms is entirely overcome by the addition of the proper amount of oxygen.

Although nitrous oxid with air is more highly spoken of by some,⁶ it will never be used extensively in major surgery, because air with nitrous oxid does not overcome the asphyxial element and oxygen does. The reason is in order to acquire a surgical anesthesia the gas must be given almost pure (about 90 parts nitrous oxid). It takes five times more air than oxygen to prevent symptoms of asphyxia,***** allowing only forty to sixty parts nitrous oxid, which is not sufficient for surgical anesthesia and will suffice only where the patient is in a very weak condition requiring a small amount of any anesthetic to cause narcosis as illustrated by Case No. VIII. Thus nitrous oxid and air results in more of an analgesia than an anesthesia, unless enough is given to get narcosis from the combined action of asphyxiation and nitrous oxid anesthesia.

I have used nitrous oxid with air in an abscess of the lung, a curettment, and in double decapsulation of the kidneys. Case VIII illustrates the type of case in which it is successful.

Case VIII. Double decapsulation kidneys in last stages of nephritis. Nitrous oxid and air anesthesia lasting 50 minutes. The man was very emaciated and almost blind from albuminuric retinitis. Patient never free from severe headache and vomited frequently. The patient was very weak and took less than 100 gallons nitrous oxid for total anesthesia. Differing from the nitrous oxid and oxygen anesthesia, he never became surgically anesthetized and occasionally moved his head and mumbled unintelligently. The sleep caused by nitrous oxid and oxygen is usually profound, but by adding air alone anesthesia is incomplete and nitrous oxid has a much more limited field.

Advantages of Nitrous Oxid Over Other General Anesthetics. 1. No degenerative changes have ever been demonstrated in any part of the body after its use. There are always some degenerative changes in the liver⁷ and sometimes in other viscera following the use of chloroform and occasionally after ether. After these drugs numerous deaths have come from post-anesthetic acidosis.⁸ It is common to find casts in the urine after ether, chloroform and spinal anesthesia.⁹

2. There are no harmful blood changes.¹⁰ After ether there is a slight anemia and decrease in coagulation time. After chloroform there is a distinct anemia and hemolysis.

3. It does not add to the element of shock¹¹ as do other anesthetics, being ideal in critical cases apart from serious cardiac conditions.¹²

4. It does not decrease immunity to infection.*****

5. There is no danger of post-operative pneumonia.

6. There is a great decrease in post-operative nausea and vomiting. Teter had in 13,000 cases only five who vomited continuously after nitrous oxid, the longest case lasting only six hours.¹³

7. Surgical anesthesia is attained in from 2½ to 4 minutes.

8. There is almost immediate recovery after the gas is discontinued.

9. During the operation the patient has no mucus, rarely vomits and the tongue never falls back.

10. It is ideal in obstetrical work, as it causes analgesia or even anesthesia, without muscular relaxation. It acts rapidly and is eliminated rapidly.

11. It will probably be a great advantage in thoracic surgery, as it has been used with success experimentally on animals.²

12. Nitrous oxid and oxygen is the safest known anesthetic. Bevan estimates the death rate to be one in 50,000, while the death rate from other anesthetics ranges from one in 1,000 to one in 15,000.†

Disadvantages. 1. It is expensive, costs from \$6 to \$9 per hour for material. The rebreathing method used in 700 cases recently at Johns Hopkins greatly reduces cost.¹⁶

2. It requires a special apparatus.

3. There is much more muscular rigidity than with ether, but morphin and small amounts of ether overcome it when present. Some surgeons learn to accustom themselves to it on account of the improved condition of their patients.

4. There is some danger from suboxidation, and venous congestion in certain cases, as in alcoholics and obese men.

5. It is counterindicated in serious heart conditions on account of the increased work put on the right heart from venous engorgement if any cyanosis is present.

6. It requires more skill to administer than other anesthetics. To quote from Crile, "It has certain dangers which are almost wholly in the hands

of the skilled anesthetist; it is not the anesthetic of choice for the uninitiated, but only for the highly trained anesthetist."

* Geo. Crile, A. D. Bevan, C. Webster, Howard Kelley, Halstead, Andrews, Parker, Kolisher, Beck, Baccus, Lobdell, etc.

** By heating nitrous oxid about 100 gal. less gas is used an hour beside causing a deeper narcosis, more complete relaxation and less cyanosis.

*** Morphin quiets patient, gives better relaxation and less anesthetic is required after its use, and aids in avoiding shock. (5)

**** Gwathney has proved experimentally on dogs that even when respiration ceases it begins again spontaneously after removal of the gas and that it is almost impossible to kill an animal with nitrous oxid.

***** The cyanosis is, of course, very different from that caused by other general anesthetics, being deficient oxygenation merely while the cyanosis of ether and chloroform is due either to impaired heart action or to atony of the capillary vessels.

***** Crile says, "The difference is so striking that only a great emergency would now induce us to use ether instead of nitrous oxid in grave infections."

† Hewitt says (14), "There is no form of anesthesia at present known which is so devoid of danger as that which results from nitrous oxid when administered with a sufficient percentage of oxygen to prevent all asphyxial complications." He had given it 17,000 times. Thomas, of Philadelphia, (15) has given it 271,940 times with only one death.

REFERENCES.

1. Geo. Crile. Society proceeding Southern Surg. & Gyn. Ass. Jour. A. M. A., p. 233, Vol. LIV, Jan. 13, 1910.
2. The Use of Nitrous Oxid and Oxygen to Maintain Anesthesia and Positive Pressure for Thoracic Surgery. Sterling Bunnell. Cal. State Jour. of Med., Jan., 1910.
3. Nitrous Oxid, Ether Nitrous Oxid and Oxygen Sequence. Symposium of Anesthetics. Jour. Surg. Gyn. & Obstet., May, 1909.
4. Nitrous Oxid and Oxygen and Warming Vapors. Gwathney. A. M. Jour. Surg., N. Y., 1908, XXII, 212-14. Warm Versus Cold Anesthetics. Gwathney. N. Y. State Jour. M., 1908.
5. Anesthesia in 5400 Patients. Wenger. Detroit Med. Jour., Oct., 1909.
6. Anesthetics for Dental Surgery. Noel. Jour. A. M. A., Aug. 7, 1909.
7. Chloroform Poisoning. Liver Narcosis and Repair. Whipple and Sperry. Johns Hopkins Hospital Bulletin, Sept., 1909.
An Experimental Study of Metabolism and Pathology of Delayed Chloroform Poisoning. J. Harland and Richards. Jour. Exp. Med., Vol. XI, No. 2, March 1, 1909. (Contains many other references.)
8. Post Anesthetic Acidosis. F. F. Gundrum. Johns Hopkins Hosp. Bulletin, June, 1909.
Acid Intoxication and Late Poisonous Effects of Anesthetics. A. D. Bevan and H. B. Farrell.
9. Action of General and Spinal Anesthesia on Kidneys and Urinary Secretion. M. Hirsch. Centralblatt für die Grenzgebiete der Med. und Chir. Jena, Dec. 31, XI, No. 29, pp. 929-930.
10. Blood Changes Incident to Surgical Anesthesia with Special Reference to those Induced by Nitrous Oxid. Hamburger and Ewing. Jour. A. M. A., Vol. LI, Nov. 7, 1909.
11. Nitrous Oxid and Oxygen in Comparison with Ether Anesthesia. Geo. Crile. Cleveland Med. Jour., June, 1909.
12. Report of Cases of Gas-air Anesthesia in Major Surgery. E. Archibald. Montreal Med. Jour., Aug., 1909.
13. Thirteen Thousand Administrations of Nitrous Oxid and Oxygen as an Anesthetic. Chas. K. Teter. Jour. A. M. A., pp. 453, Aug., 1909.
14. Anesthetics and Their Administration. Hewitt. 1907 Edition, Lond., Eng.
15. Preliminary Report of the Anesthetic Commission of the A. M. A. Jour. A. M. A., Nov. 7, 1908, Vol. LI, p. 1576.
16. Nitrous Oxid-Oxygen Anesthesia by the Method of Rebreathing, with Especial Reference to the Prevention of Surgical Shock. Willis B. Gatch. Jour. A. M. A., March 5, 1910.

FRONTAL SINUS SUPPURATION.*

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On the subject of Frontal Sinus Suppuration, assigned to me for this evening, I will confine my remarks to a few points, lest I occupy too much of your time.

1st. Its Occurrence: There is no doubt that frontal sinus suppuration occurs more frequently than the general practitioner realizes, but not so frequently as suppurative otitis media. We specialists are apt to imagine we see hundreds of cases and yet if you carefully go over your records *you* are surprised to see how few case-records show frontal sinus suppuration. I have from my private records, twelve acute and thirty-four chronic cases. Of course, this does not include the many cases of "cold in the head," where for the time being there is in almost every case some inflammation of the frontal sinus. When one realizes that out of the thousands of cases of "cold in the head," but a few cases of frontal sinus suppuration remain as after results, one must come to the conclusion that Nature takes care of the great majority of all cases. Recovery takes place just as recovery takes place in cases of acute bronchitis, acute pharyngitis, acute pneumonia and other acute infectious diseases, which are self-limiting. But in the small minority of cases of "cold in the head," recovery is incomplete, one or both sinuses being left in a state of empyema. Such cases certainly need to be diagnosed, for most of them are capable of being cured. The patients themselves rarely complain of anything except "catarrh," but vague symptoms, such as dull headache and eyeache are frequently present.

2nd. Diagnosis: Antrum suppuration can be proven absolutely in every case by use of a trochar. On the contrary, frontal sinus suppuration can not be always proven without external operation, for in many cases I believe most of us will fail to satisfactorily catheterize the frontal. But we do have other means of arriving at a fairly sure diagnosis—1st, the presence of pus in the middle meatus, while equally significant of anterior ethmoidal disease, is nevertheless fairly indicative of frontal suppuration if the pus continues to drip, even after cleansing and mopping away, provided the antrum has been excluded by puncture; 2nd, trans-illumination in every nasal case should be a regular routine procedure. It is simple and quickly done. I think it of great diagnostic value, even though you may find it at times misleading. Suppose that it does fail you in a few cases, but serves you in the majority of cases, it is

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